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(54) Lubricating Oils Containing Additives

(57) The oils comprise (1) from 0.1 to 25% of a polymeric viscosity index improver additive which is, (a) a tapered or block copolymer of a vinyl aromatic monomer and a conjugated diene e.g. a styrene/isoprene block copolymer or (b) a copolymer of ethylene and a C₃₋₁₄ mono-olefine, norbornene, a C₆₋₈ diolefine, dicyclo-

pentadiene or 5-methylene-2-norbornene e.g. an ethylene/propylene terpolymer, (2) a dispersant derived from (a) a substituted olefinically saturated mono- or polycarboxylic acid, e.g. a polyisobutene substituted succinimide or (b) an alkaline earth metal hydrocarbon sulphonate, and (3) a lubricating oil.

The effect of the second component is to reduce the viscosity of oil solutions of the first component thereby assisting additive formulation.

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SPECIFICATION Lubricating Oil Additive Composition

The present invention relates to a lubricating oil additive composition and to lubricating oil compositions containing such an additive composition.

5 Lubricating oils are normally classified in terms of their viscosity at some standard temperature but equally important is a property known as the viscosity index, which is an empirical number giving a measure of the extent to which the viscosity of an oil decreases as the temperature is raised. An oil which satisfies viscosity requirements at both extremes of the temperature range to which it may be subjected is said to have a high "viscosity index". This property can be controlled to some extent by refining but in recent years the trend has been towards "multi-grade" oils of extremely high viscosity index, in which certain polymeric compounds which function as viscosity index improvers are added. One such polymer is the tapered or block copolymer containing units derived from a vinyl-aromatic monomer and units derived from a conjugated diene monomer e.g. styrene/butadiene and styrene/isoprene block and tapered copolymers.

15 Another type of polymer commonly encountered as a viscosity index improver additive is that conventionally known as an ethylene/propylene copolymer. Normally such copolymers contain a small proportion of a third monomer such as 5-methylene-2-norbornene or 1,4-hexadiene.

A problem commonly encountered with the aforesaid copolymers is their low solubility in lubricating oils at ambient temperatures. Thus whilst it is possible to dissolve up to and beyond 10% by weight of the copolymers in hydrocarbon oils at elevated temperatures, on cooling the solutions tend to gel. Because of the practical difficulties associated with the handling of highly viscous solutions copolymers of the aforesaid type tend to be used in dilute solution. This is particularly a problem for the lubricant additive manufacturer who ideally markets concentrates in which the diluent is present, for economic operation, in the minimum amount consistent with compatibility. The difficulties encountered during the formulation of lubricating compositions containing vinyl aromatic/diene tapered and block copolymers have been enumerated in U.S. Patent Nos. 3,630,905; 3,772,169 and 3,994,815 which propose methods for overcoming the problem. In particular USP 3,772,169 describes prevention of the gelling tendency by incorporating small amounts of a polyester of an olefinically unsaturated acid in the oil solution and USP 3,994,815 describes the initial preparation of a concentrate using a non-ester type synthetic lubricating oil diluent or carrier e.g. of the alkylated aromatic type, the polyolefin type, the chlorofluorocarbon type and the polyphenyl ether type, in which the copolymer is more soluble.

Our British Patent No. 1,529,333 and our copending application No. 53013/76 describe another approach to the problem which involves the addition of a polybutene having a number average molecular weight in the range 5,000 to 60,000.

We have now found that the viscosity of lubricating oil solutions of copolymers of the aforesaid type can be reduced by the addition of (i) a dispersant derived from a substituted mono- or polycarboxylic acid wherein the substituent is a substantially hydrocarbon group containing more than 30 carbon atoms, or (ii) an alkaline earth metal hydrocarbon sulphonate or (iii) a mixture of (i) and (ii).

40 Accordingly the present invention provides a lubricating oil additive composition which composition comprises as a first component from 0.1 to 25% of one or more copolymers selected from tapered and block copolymers derived from a monovinyl aromatic monomer and a conjugated diene and copolymers comprised of from 25 to 75% by weight of units derived from ethylene and from 75 to 25% by weight of units from more than one comonomer selected from (a) terminally unsaturated straight-chain mono olefins having from 3 to 14 carbon atoms, (b) norbornene, (c) terminally unsaturated non-conjugated diolefins having from 5 to 8 carbon atoms, (d) dicyclopentadiene and (e) 5-methylene-2-norbornene, with the proviso that one and no more than one comonomer from (a) is present in the copolymer, as a second component one or more of:

(i) a dispersant derived from a substituted olefinically saturated mono- or poly-carboxylic acid wherein the substituent is a hydrocarbon group containing more than 30 carbon atoms, (ii) an alkaline earth metal hydrocarbon sulphonate, and as a third component a lubricating oil, the percentages of the components being expressed by weight based on the total weight of the composition.

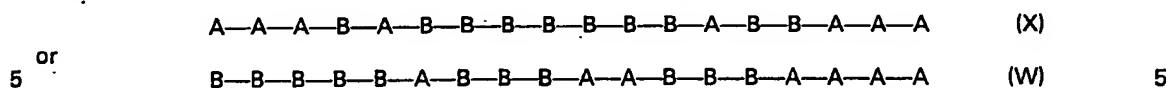
With regard to the first component the terms "tapered" and "block" copolymer are well-known in the art. When used in this specification the term "block" copolymer means that type of copolymer formed from two or more monomers in which the respective monomers are present in the individual polymer chains in substantially homopolymeric blocks. Thus if A represents a molecule of a vinyl aromatic monomer and B a molecule of a diene the block copolymers encompassed by the present invention have the essential chain structure:

60 A-A-A-A-A-A-A-A-B-B-B-B-B-B-B-B-B-B (Z) 60

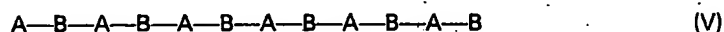
or

A-A-A-A-B-B-B-B-B-B-B-B-B-B-B-A-A-A-A (Y)

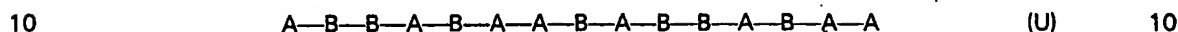
"Tapered" copolymers are similar in nature but the individual homopolymeric blocks are generally not as pure. Their chain structures may be represented as follows:



The terms do not include copolymers known in the art as statistical or alternating copolymers having the chain structure:



or random copolymers having the chain structure:



Block and tapered copolymers may be prepared by techniques well-known in the art. The most common technique involves anionic polymerisation of the type generally known as "living polymerisation" because of the ability of the polymer chains to grow by addition of further monomer. In this method a predetermined amount of a polymerisation initiator such as an organolithium compound, e.g. *n*- or *sec*-butyl lithium, dissolved in a hydrocarbon solvent is added to a predetermined quantity of the vinyl aromatic monomer A, preferably in the presence of a diluent, which diluent may be a hydrocarbon solvent, e.g. toluene. After the vinyl aromatic monomer is completely polymerised pure diene B is added. The non-terminated vinyl aromatic polymer chains initiate polymerisation of the diene which adds thereto until the diene is consumed. If a block copolymer of structure (Z) is desired the polymer chains are inactivated by the addition of a suitable monofunctional terminating agent, e.g. methanol, or if a copolymer of structure (Y) is desired a further quantity of the vinyl aromatic monomer is added prior to termination. Clearly the sequential additions may be continued to build up any number of homopolymeric blocks. The molecular weight of the copolymer is a function of the number of moles of initiator and monomer present. Tapered copolymers of structure (X) may be obtained by adding a mixture of the vinyl aromatic monomer A and the diene B to a hydrocarbon solution of an unterminated vinyl aromatic polymer which acts as a polymerisation initiator. Since the tendency of B to be incorporated in the copolymer greatly exceeds that of A the composition of each copolymer molecule formed during copolymerisation gradually changes from that of nearly pure poly-B to that of nearly pure poly-A. Tapered copolymers of structure (W) may be prepared by copolymerising in a hydrocarbon solvent an initial mixture of A and B in the presence of an alkali metal or alkali metal compound. Clearly this process may be repeated to form a multi-block tapered copolymer. Many further variations are possible using multifunctional initiators and chain terminating agents.

Although the monovinyl aromatic monomer from which the tapered or block copolymer is derived may be a vinyl di- or poly aromatic compound such as vinyl naphthalene it is preferably a monovinyl monoaromatic compound such as styrene or an alkylated styrene e.g. α -methyl styrene and *p*-tert-butylstyrene or a halogen-containing styrene. Preferably the monovinyl aromatic compound is styrene. The diene may be butadiene or isoprene of which isoprene is preferred. The molecular weight of the copolymers which may be used in the compositions of the invention may vary within wide limits, for instance between 10,000 and 400,000, preferably between 20,000 and 125,000. The copolymers may contain from 5 to 50% by weight of the vinyl aromatic monomer and from 95 to 50% by weight of the diene.

Preferably the tapered or block copolymers are hydrogenated to improve their thermal stability. Suitable methods of hydrogenation are described in US Patent Nos. 3,113,986 and 3,205,278 in which there is employed as catalyst an organo-transition metal compound and a trialkyl aluminium (e.g. nickel acetylacetonate or octoate and triethyl or tri-isobutyl aluminium). The process allows more than 95% of the olefinic double bonds and less than 5% of the aromatic nucleus double bonds to be hydrogenated. Alternatively the method described in US Patent No. 2,864,809 employing a nickel on kieselguhr catalyst may be employed. After hydrogenation the catalyst may be removed by treating the hydrogenated copolymer with a mixture of methanol and hydrochloric acid. The solution so obtained is decanted, washed with water and dried by passage through a column containing a drying agent.

Suitably the tapered or block copolymer may be a hydrogenated styrene/isoprene block copolymer of number average molecular weight in the range 50,000 to 100,000 and containing about 75% isoprene and 25% styrene, greater than 95% of the isoprene component being present in the 1,4-form in which greater than 95% of the olefinic double bonds are hydrogenated and the styrene component having less than 5% of the aromatic nucleus double bonds hydrogenated.

Where the first component comprises an ethylene copolymer this preferably contains from 25 to 64%, even more preferably 25 to 55% by weight of units derived from ethylene and from 75 to 36, even more preferably from 75 to 45% by weight of units derived from more than one of the comonomers (a), (b), (c), (d) and (e) as hereinbefore specified. Preferably, the ethylene copolymer contains no more than 10% by weight of units derived from the comonomers (b), (c), (d) and (e).

Suitably terminally unsaturated straight-chain mono olefins having from 3 to 14 carbon atoms [(a)] include propylene, 1-butene, 1-pentene, 1-hexene, 1-heptene, 1-octene, 1-nonene, 1-decene and mixed alkenes having 12 to 14 carbon atoms. Preferably the straight-chain mono olefin is propylene.

Suitable terminally unsaturated non-conjugated diolefins having from 5 to 8 carbon atoms [(c)] include 1,4-pentadiene, 1,4-hexadiene, 1,5-hexadiene, 2-methyl-1,5-hexadiene, 1,6-heptadiene and 1,7-octadiene. Preferably the diolefin is 1,4-hexadiene. 5

The weight average molecular weight of the ethylene copolymers is suitably in the range 40,000 to 150,000. Preferably the molecular weight distribution, as determined by dividing the weight average molecular weight by the number average molecular weight, is less than 8, even more preferably less than 5. 10

Suitable ethylene copolymers which may be used in the compositions of the present invention are ethylene/propylene/5-methylene-2-norbornene terpolymers and ethylene/propylene/1,4-hexadiene terpolymers.

Methods for preparing oil-soluble ethylene copolymers are well-known in the art. Representative of such art is the book entitled "Linear and Stereoregular Addition Polymers" by Gaylord and Mark, published by Interscience Publishers, New York, NY 1959. US Patent Nos. 2,799,688; 2,975,159; 2,933,480; 3,598,738 and 3,691,142 and Canadian Patent No. 85574 are also representative of such art. A variety of suitable ethylene copolymers are commercially available. 15

With regard to the second component the dispersant (i) is suitably derived from a substituted polycarboxylic acid wherein the substituent is a hydrocarbon group containing more than 30 carbon atoms. The size of the hydrocarbon substituent is determined by both oil-solubility and dispersancy considerations. Preferably the substituent contains more than 50 carbon atoms. Preferably also the substituent is substantially saturated, i.e. preferably more than 95%, even more preferably more than 98%, of the total number of carbon to carbon covalent linkages are saturated linkages. Furthermore, although the substituent may contain polar groups they should not be present in such a proportion that the essentially hydrocarbon nature of the substituent is not modified to any extent. Preferably also the substituent should not contain oil-solubilising pendant groups, that is groups having more than 6 aliphatic carbon atoms in the backbone chain. The substituent is suitably derived from a high molecular weight substantially saturated petroleum fraction, an olefin polymer such as polyethylene, polypropylene or a polybutene, preferably polyisobutene, or an olefin copolymer. 20 25 30

An especially suitable polycarboxylic acid is a substituted succinic acid or a substituted succinic anhydride which may be prepared by reacting maleic anhydride with a high molecular weight olefin or a chlorinated hydrocarbon such as a chlorinated polyolefin. The product from such a reaction is a substituted succinic anhydride wherein the substituent is derived from the olefin or the chlorinated hydrocarbon. The product may be hydrogenated to remove any ethylenic unsaturation or hydrolysed to succinic acid. 35

The substituted polycarboxylic acid or anhydride may then be reacted with, for example, at least one-half an equivalent amount of an amine of formula:



in which formula (1) the substituent R^1 is a C_1 to C_6 alkyl radical or hydrogen and x is an integer, to form a dispersant which will hereinafter be referred to as a succinimide. Amines of formula (1) are generally known as ethylene amines. The group R^1 may be a C_1 to C_6 alkyl group but is preferably hydrogen. 40

Suitable amines of formula (1) are ethylene diamine, diethylene triamine, triethylene tetramine and pentaethylene hexamine. Such compounds are well-known in the art and are generally prepared by reacting ethylene dichloride with ammonia. Whilst at least one half of a chemical equivalent amount of the amine of formula (1) per equivalent of substituted succinic acid or anhydride must be used in the production of the succinimide up to 2.0 chemical equivalents may be used. The chemical equivalency of the amine reactant is based upon the nitrogen content thereof. Thus triethylene tetramine, for example, has four equivalents per mole. Further details regarding succinimides and their preparation may be found in British Patent Specification No. 922,831. A particularly useful succinimide is the bis-succinimide obtained by reacting a substituted succinic anhydride wherein the substituent is derived from a polyisobutene of molecular weight about 1000 with an equimolar amount of triethylene tetramine. Another particularly useful succinimide is the mon-succinimide obtained by employing 2 moles of triethylene tetramine in the aforesaid reaction. 45 50

Alternatively the substituted polycarboxylic acid or anhydride may be reacted with a polyhydric alcohol to form a dispersant which is an ester. These esters are well-known in the prior art of which British Patent Specification No. 1,250,994 is typical. The polyhydric alcohol may suitably contain from 2 to 10 hydroxyl groups. Examples of such alcohols include alkylene glycols such as ethylene glycol, propylene glycol, and butylene glycol and polyglycols such as di-, tri and tetra-ethylene glycol, di- and tri-propylene glycol, di- and tri-butylene glycol and other alkylene glycols and polyalkylene glycols in which the alkylene radical contains from 2 to 8 carbon atoms. An especially preferred class of polyhydric alcohols are the polyhydric alkanols containing from 3 to 6 carbon atoms and having at least 60

three hydroxyl groups. Such alcohols include glycerol, erythritol, pentaerythritol, mannitol, sorbitol and 1,2,4-hexanetriol. A particularly preferred ester is that produced by reacting up to 100% molar excess, preferably from 5 to 25% molar excess, of pentaerythritol with a polyisobutenyl succinic anhydride wherein the polyisobutenyl substituent is derived from a polyisobutene having a molecular weight of about 1000.

The alkaline earth metal hydrocarbon sulphonates (ii) are also well-known compounds which are added to lubricating oils as detergents. The alkaline earth metal may be calcium, magnesium or barium, of which calcium and magnesium are preferred. The sulphonate may be normal or overbased.

Representative of the art describing the preparation of these materials are British Patent Specification Nos. 1,153,200; 1,000,672; 1,166,744; 1,394,028 and 1,297,150. The hydrocarbon sulphonate suitably contains at least 20 carbon atoms, preferably from 20 to 100 carbon atoms, and may be an aliphatic, e.g. alkyl, substituted cyclic sulphonate. The preferred sulphonates are the petroleum sulphonates, commonly called "mahogany sulphonates". These are acids which are for the most part alkyl substituted alicyclic acids. Other sulphonates which may be used include the alkyl naphthalene sulphonates, such as dinonyl naphthalene sulphonate and the alkyl benzene sulphonates containing at least 20 carbon atoms. The alkyl benzene sulphonates are generally made by alkylation of benzene with olefins such as polypropylene and polybutylene, followed by sulphonation of the aromatic ring.

The lubricating oil forming the third component of the compositions may comprise a synthetic lubricating oil, such as an ester oil or a polyolefin oil, but is preferably a mineral lubricating oil which may be prepared from a crude mineral oil by conventional processes, such as distillation, extraction, deasphalting, dewaxing, hydrofining, polymerisation and the like. It is preferred to use mineral lubricating oils obtained from paraffinic crude oils. Preferably the lubricating oil is a solvent neutral base oil, suitably a 100 to 150, preferably a 130 to 150 solvent neutral oil. Solvent neutral oils are generally non-volatile mineral oils which have been refined, generally by solvent extraction, to remove acidic and alkaline components.

Preferably the composition comprises from 0.1 to 20% even more preferably from 0.1 to 10% by weight of the first component and from 0.5 to 60%, even more preferably from 1 to 20% by weight of the second component, the remainder of the composition being a lubricating oil.

The composition may also contain other conventionally added to finished lubricating oil compositions. Thus for example there may also be incorporated an antioxidant and/or an anti-wear agent such as a zinc dithiophosphate. Furthermore there may also be incorporated another viscosity index improver. A particularly preferred additional viscosity index improver is a polyisobutene. Polyisobutenes which are not viscosity index improvers may also be added.

Generally it is expedient to employ elevated temperatures e.g. 75 to 200°C, preferably 120 to 180°C, in order to aid dissolution of the copolymers in the lubricating oil. The solution process is also aided by shredding the copolymer and agitation of the solution. Preferably also the dissolution is carried out in an atmosphere of an inert gas such as nitrogen. The copolymers may be dissolved in a solution of one or more of (i), (ii) and (iii) (the second component) in lubricating oil or each of the first and second components may be dissolved separately in the lubricating oil.

According to another aspect of the present invention there is provided a finished lubricating oil composition comprising a major proportion of a lubricating oil and a minor proportion of the lubricant additive composition as hereinbefore described.

The invention will now be illustrated by reference to the following Examples.

In the Examples the following solutions were used:

A. A 60% by weight solution in lubricating oil of the monosuccinimide produced by reacting one mole of triethylene tetramine with two moles of a substituted succinic anhydride, the substituent being a polyisobutenyl group having a molecular weight of about 1000. The viscosity of the solution measured at 100°C (V_{100})=250 cS.

B. A 10% by weight solution in 100 solvent neutral lubricating oil of a hydrogenated styrene/isoprene block copolymer of number average molecular weight in the range 50,000 to 100,000 and containing about 75% isoprene and 25% styrene, greater than 95% of the isoprene component being present in the 1,4-form in which greater than 95% of the olefinic double bonds are hydrogenated and the styrene component having less than 5% of the aromatic nucleus double bonds hydrogenated $V_{100}>10,000$ cS.

C. A 10% by weight solution of the hydrogenated styrene/isoprene block copolymer of B in spindle oil $V_{100}>10,000$ cS.

D. A 10% by weight solution in LP501 oil of an ethylene/propylene/1,4-hexadiene terpolymer in which the ethylene/propylene ratio is about 45:55 and the 1,4-hexadiene content is about 3% by weight $V_{100}=2,500$ cS.

E. An 11.5% by weight solution of another ethylene/propylene/1,4-hexadiene copolymer in LP501.

F. A solution of polyisobutenyl succinic anhydride in lubricating oil having a PIBSA No. of 61.7, i.e. about 35% oil, the polyisobutenyl group having a molecular weight of about 1000. $V_{100}=90.9$ cS.

G. An approximately 50% solution in lubricating oil of a slightly overbased calcium petroleum sulphonate, containing slightly more than the stoichiometric amount of metal. $V_{100}=92.5$ cS.

H. An approximately 50% solution in lubricating oil of an overbased calcium petroleum sulphonate.

I. A 45% by weight solution in 150 solvent neutral oil of a polybutene having a number average molecular weight in the range 30,000 to 42,000.

- | | | |
|----|--|----|
| 5 | Example 1
90% by weight of solution A was mixed with 10% by weight of solution B. $V_{100}=187.0$ cS. | 5 |
| | Example 2
80% by weight of solution A was mixed with 20% by weight of solution B. $V_{100}=143.0$ cS. | |
| 10 | Example 3
70% by weight of solution A was mixed with 30% by weight of solution B. $V_{100}=143.0$ cS. | 10 |
| | Example 4
60% by weight of solution A was mixed with 40% by weight of solution B. $V_{100}=178.0$ cS. | |
| | Example 5
50% by weight of solution A was mixed with 50% by weight of solution B. $V_{100}=173.0$ cS. | |
| 15 | Example 6
40% by weight of solution A was mixed with 60% by weight of solution B. $V_{100}=212$ cS. | 15 |
| | Example 7
90% by weight of solution A was mixed with 10% by weight of solution C. $V_{100}=189.0$ cS. | |
| 20 | Example 8
80% by weight of solution A was mixed with 20% by weight of solution C. $V_{100}=139.5$ cS. | 20 |
| | Example 9
70% by weight of solution A was mixed with 30% by weight of solution C. $V_{100}=135.7$ cS. | |
| | Example 10
60% by weight of solution A was mixed with 40% by weight of solution C. $V_{100}=175.4$ cS. | |
| 25 | Example 11
50% by weight of solution A was mixed with 50% by weight of solution C. $V_{100}=181.3$ cS. | 25 |
| | Example 12
40% by weight of solution A was mixed with 60% by weight of solution C. $V_{100}=234$ cS. | |
| 30 | Example 13
30% by weight of solution A was mixed with 70% by weight of solution C. $V_{100}=491$ cS. | 30 |
| | Example 14
90% by weight of solution A was mixed with 10% by weight of solution D. $V_{100}=188.9$ cS. | |
| | Example 15
80% by weight of solution A was mixed with 20% by weight of solution D. $V_{100}=156.0$ cS. | |
| 35 | Example 16
90% by weight of solution A was mixed with 10% by weight of solution E. $V_{100}=185.6$ cS. | 35 |
| | Example 17
80% by weight of solution A was mixed with 20% by weight of solution E. $V_{100}=175.0$ cS. | |
| 40 | Example 18
90% by weight of solution F was mixed with 10% by weight of solution B. $V_{100}=84.8$ cS. | 40 |
| | Example 19
80% by weight of solution F was mixed with 20% by weight of solution B. $V_{100}=86.5$ cS. | |
| | Example 20
70% by weight of solution F was mixed with 30% by weight of solution B. $V_{100}=103.0$ cS. | |
| 45 | Example 21
60% by weight of solution F was mixed with 40% by weight of solution B. $V_{100}=133.4$ cS. | 45 |

Example 22

50% by weight of solution F was mixed with 50% by weight of solution B. $V_{100}=276.3$ cS.

Example 23

90% by weight of solution G was mixed with 10% by weight of solution B. $V_{100}=70.9$ cS.

5 Example 24

70% by weight of solution G was mixed with 30% by weight of solution B. $V_{100}=45.0$ cS.

Example 25

50% by weight of solution G was mixed with 50% by weight of solution B. $V_{100}=39.0$ cS.

Example 26

10 90% by weight of solution H was mixed with 10% by weight of solution B. $V_{100}=80.6$ cS.

Example 27

70% by weight of solution H was mixed with 30% by weight of solution B. $V_{100}=94.3$ cS.

Example 28

15 5% by weight of solution I was mixed with 95% by weight of a 50:50 (parts by weight) mixture of solution A/solution B. $V_{100}=186.4$ cS.

Example 29

10% by weight of solution I was mixed with 90% by weight of a 50:50 (parts by weight) mixture of solution A/solution B. $V_{100}=230.1$ cS.

Example 30

20 20% by weight of solution I was mixed with 80% by weight of a 50:50 (parts by weight) mixture of solution A/solution B. $V_{100}=238.5$ cS.

Examples 1 to 12 demonstrate that a composition having a lower viscosity than either of the individual components alone is achieved by mixing as the first component a styrene/isoprene block copolymer with as the second component a succinimide dispersant with lubricating oil over the range from 1% by weight copolymer; 54% by weight dispersant; 45% lubricating oil to 6% by weight copolymer; 24% by weight dispersant; 70% by weight lubricating oil.

Examples 14 to 17 demonstrate the same effect in the case where the copolymer is an ethylene/propylene/1,4-hexadiene terpolymer.

30 Examples 18 to 22 demonstrate the viscosity reduction effect in the case of compositions containing a styrene/isoprene block copolymer, a polyisobutenyl succinic anhydride and lubricating oil.

Examples 23 to 25 demonstrate the viscosity reduction effect in the case of compositions containing a styrene/isoprene block copolymer, a slightly overbased calcium petroleum sulphonate and a lubricating oil.

35 Examples 26 and 27 demonstrate the viscosity reduction effect in the case of compositions containing an overbased calcium petroleum sulphonate and a lubricating oil.

Examples 28 to 30 demonstrate the effect of adding a polybutene to the composition containing a styrene/isoprene block copolymer, a succinimide dispersant and a lubricating oil.

Claims

40 1. A lubricating oil additive composition which composition comprises as a first component from 0.1 to 25% of one or more copolymers selected from tapered and block copolymers derived from a vinyl aromatic monomer and a conjugated diene and copolymers comprised of from 25 to 75% by weight of units derived from ethylene and from 75 to 25% by weight of units from more than one comonomer selected from (a) terminally unsaturated straight-chain mono-olefins having from 3 to 14 carbon atoms (b) norbornene (c) terminally unsaturated non-conjugated diolefins having from 5 to 8 carbon atoms, (d) dicyclopentadiene and (e) 5-methylene-2-norbornene, with the proviso that one and no more than one comonomer from (a) is present in the copolymer, as a second component one or more of:

50 (i) a dispersant derived from a substituted olefinically saturated mono- or poly-carboxylic acid wherein the substituent is a hydrocarbon group containing more than 30 carbon atoms, and (ii) an alkaline earth metal hydrocarbon sulphonate, and as a third component a lubricating oil.

2. A composition according to claim 1, wherein the first component is a copolymer derived from a monovinyl aromatic monomer which is styrene in an amount in the range 5 to 50% by weight and a conjugated diene which is isoprene in an amount in the range 95 to 50% by weight, the copolymer having a molecular weight in the range 20,000 to 125,000.

55 3. A composition according to either claim 1 or claim 2, wherein the first component is a copolymer derived from a monovinyl aromatic monomer and a conjugated diene which copolymer is hydrogenated.

4. A composition according to claim 1, wherein the first component is a copolymer comprised of from 25 to 64% by weight of units derived from ethylene and from 75 to 36% by weight of units derived from propylene and one or more of the comonomers (b), (c), (d) and (e), the copolymer containing no more than 10% by weight of units derived from the comonomers (b), (c), (d) and (e) and having a weight average molecule weight in the range 40,000 to 150,000. 5
5. A composition according to claim 4, wherein the first component is either an ethylene/propylene/1,4-hexadiene terpolymer or an ethylene/propylene/5-methylene-2-norbornene terpolymer.
6. A composition according to any one of the previous claims, wherein the second component is a dispersant derived from a substituted succinic acid wherein the substituent is derived from a polyisobutene containing more than 30 carbon atoms. 10
7. A composition according to claim 6, wherein the dispersant is a succinimide.
8. A composition according to claim 6, wherein the dispersant is an ester of a polyhydric alkanol containing from 3 to 6 carbon atoms and having at least three hydroxyl groups.
9. A composition according to any one of claims 1 to 5, wherein the second component is an alkaline earth metal hydrocarbon sulphonate. 15
10. A composition according to any one of the previous claims, wherein the lubricating oil is a 100 to 150 solvent neutral mineral lubricating oil obtained from a paraffinic crude oil.
11. A composition according to any one of the previous claims which composition comprises from 0.1 to 10% by weight of the first component and from 1 to 20% by weight of the second component, the remainder of the composition being a lubricating oil. 20
12. A composition according to any one of the previous claims which composition additionally contains a polyisobutene.
13. A composition substantially as hereinbefore described with reference to Examples 1 to .
14. A finished lubricating oil composition comprising a major proportion of a lubricating oil and a minor proportion of the lubricating additive composition as claimed in claims 1 to 13. 25

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